SUTURES AND LIGATURES

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Historical sketch of their use. It is known that sutures and ligatures of various materials have been used occasionally by surgeons for the closure of wounds and for the control of hemorrhage from a very early period. For many centuries in India and China little or nothing was known about ligatures and their use; hemorrhage was entirely controlled by means of the cautery, boiling oil, and pressure. In fact, for a very long time in all countries only here and there were ligatures used by surgeons. Albucasis, a famous physician of the Arabian School, who lived and wrote in 1105 B.C. speaks of the use of ligatures. They were used by Galen in the Alexandrian School in the first century B.C. and were introduced into Rome by Euelpistus shortly before the time of Celsus. Among the Hebrews, as witnessed by the Talmud, the Rabbis were acquainted, prior to 200 A. D. with the use of sutures for the closure of wounds and with ligatures for the control of hemorrhage.

For the first sixteen centuries of the Christian era, hemorrhage was controlled by means of the cautery almost without exception. In 1564, Ambroise Pare, a French surgeon, earnestly advocated and practiced the use of ligatures. The German surgeons up to the seventeenth century controlled hemorrhage by the use of the cautery, even Fabricius Hildanus, called the Father of German Surgery used it in preference to ligatures and sutures for wounds. Spain, in 1580, was checking hemorrhage by the use of the cautery and as recently as 1620, Alexander Read, in England, speaks of ligatures as a dangerous toy. During the latter part of the sixteenth century and the beginning of the seventeenth, Fabricius a surgeon of Padua, Italy, whose surgery was mainly that of Celsus, of Paul of Algina, and of Albucasis, used ligatures and speaks of animal sutures.

During the seventeenth and eighteenth centuries, Matthias Gothfried Purmann, a famous German surgeon, wrote of the control of hemorrhage by means of pressure, styptics and bandage; though objecting seriously to the use of the cautery, he did not mention employing ligatures. England, throughout the first part of the seventeenth century, with few exceptions, controlled hemorrhage by the use of the cautery.

Kinds of ligature and suture materials. The ligature and suture materials are of two varieties, non-absorbable and absorbable. The principal nonabsorbable ligature and suture materials are silk, linen, silkworm gut, horsehair, wire (silver, gold and iron) and Pagenstacher's celluloid hemp. The chief objection to their use is that a condition of encystation is produced, caused by the presence of a foreign body in the tissue, resulting in irritation and the forming of pockets and sinuses. The absorbable ligature and suture materials are catgut and kangaroo tendon. These serve the same purpose as the nonabsorbable, and as the name indicates, are eventually absorbed by the body tissues. Of these two kinds, the nonabsorbable were more generally used in modern times until 1890, when the great English surgeon, Lister, with perfected operative technique, demonstrated the successful use of the absorbable variety.

As has been said before, the absorbable ligature and suture materials have been used from early times. Albucasis describes the stitching together of wounds of the bowels with fine threads made from the intestines of animals, and the Arabian writer and surgeon, Rhazes of Bagdad, 900, A. D. tells of similar treatment for wounds of the abdomen, using as suture material strings from a harp, these being made of the twisted intestines of the sheep.

In more modern times, Dr. Physic of Philadelphia introduced an animal ligature and claimed satisfactory results from its use. This consisted of narrow strips of chamois leather rolled on a slab to make them round and hard. He tells us that these ligatures are better than silk, as they are absorbed by the fluids of the body after they have performed their function. Although Dr. Physic used these ligatures from 1806, he did not publish his results until 1814. Many surgeons in America also used these animal ligatures as did Sir Astley Cooper in England. However, for a short period they fell into disuse, but were again introduced in 1830 by Dr. St. George Jameson of Baltimore. Later, again, the animal ligatures and sutures fell into disuse, because of the septic condition of the wounds following surgical operations, which existed at this time as a result of ignorance regarding the technique in operation. This septic condition of the surgical wounds was believed to be caused by the animal sutures and ligatures and for a very long period of time they were little used by surgeons until Lister demonstrated that suppuration of wounds was caused by the introduction of germs from outside the body, and that if there were no germs there was no infection, suppuration and inflammation. This discovery of Lister's allowed the reintroduction, and successful use of aseptic animal ligatures, and sutures. After this, Lister used catgut which had been

soaked in a solution of carbolic acid, as suture material. So far as the buried animal sutures are concerned, it was for the first time, in 1870, that Dr. H. O. Marcy of Boston, a student under Lister, used the aseptic sutures in operation for strangulated hernia with good results.

Preparation of the material. During the last forty years many different substances have been put forward as making ideal suture materials, such as the tendons from the tails of the rat, squirrel, opossum, kangaroo and from the legs and fascia lata of the moose, cow, deer and other animals. These all have been rejected except the kangaroo tendon, and catgut, which are about the only animal absorbable sutures and ligatures now used by surgeons. The kangaroo tendons were introduced as a substitute for catgut by Dr. Marcy, as aforementioned.

The best kangaroo tendons come from the tail of the small Australian kangaroo, or wallaky. The tendons from a freshly killed animal are dried in the sun, and are comparatively free from germs. They are then made into bundles ready for shipment. The bundles as they come are soaked in a solution of corrosive sublimate until soft; the tendons are then separated, cleaned, and dried straight on sterile towels. These tendons are then chromicized by immersing them in a solution of potassium dichromate for varying lengths of time, and are then preserved in sealed tubes of boiled linseed oil or chloroform. Each tendon is prepared to resist absorption by the tissues, in the striated muscle for thirty days, and one-fourth of this time in serous, and mucous membrane as well as in the cervix uteri and perineum.

The objections to the kangaroo tendons are the expense, the comparative scarcity of the raw material at present, and the fact that less than ten per cent of the tendons are of a size small enough to be used. To overcome this last difficulty the manufacturer splits up the coarse tendons into the proper sizes. This, however, is far from satisfactory, as the tendons are rough, show weak spots and are apt to split again. The sizes usually range from fine, medium to heavy.

Catgut. The word catgut is a corruption of the German word kitgut. The "kit" was an old German musical instrument on which gut was used as strings, hence came the word kitgut. This word was gradually corrupted by use, language and age, until finally it was changed in its spelling to catgut.

The commercial catgut suture material is obtained from the small intestines of the sheep. It is produced in Italy, Switzerland, Germany and America. The best on the market is that made in Germany. The American product is not at all satisfactory, it is poorly twisted, has not the tensile strength, and is very rough.

There are many methods of preparing the intestines for surgical

purposes, such as suture and ligature. The first step in the process is the removing of the mucous, muscular and serous membranes from the connective tissue.

There are two ways by which this is accomplished, one is by placing the gut, after separating it from the mesentery, in a tub of cold water, and allowing it to decompose, after which it is split into ribbons. The mucous, muscular and serous coats are then removed by scraping with a knife until only the connective tissue is left intact. The disadvantage of this procedure is that there remain more or less particles of muscle and membrane, which cause great difference in the strength of the finished catgut suture.

The other method is the cumol treatment of the gut. The catgut from a freshly killed sheep, after being separated from the mesentery, is placed in cold water to take out the animal heat and to check putrefaction. It is then split into two portions by means of a round blunt pointed piece of wood, having razor-like blades attached to its periphery. The gut is drawn over the instrument and split into two parts. The split gut is placed in a tub containing a one per cent solution of sodium-bicarbonate. It is then taken from the sodium solution, scraped by means of a machine consisting of a set of rollers which draws the gut between a smooth cylinder below, and a rapidly revolving paddle wheel above, the latter revolving in an opposite direction to the movement of the gut. The ends of the blades of the paddle wheel are provided with flexible leather flappers which beat and scrape the side of the gut uppermost. The gut goes from the scraping machine into fresh sodium bicarbonate solution. This process of scraping and soaking in the sodium solution is repeated six or eight times until both sides of the gut are cleaned of everything but the submucous connective tissue. It is then bleached and disinfected by being placed in a solution of hydrogen peroxide one-third, to water two-thirds, to which has been added sufficient sodium bicarbonate to render it neutral. The solution is heated to 90° F. and is kept at this temperature for six hours, after which the gut is ready for twisting. Prepared in this way, the gut is free from muscle and mucous membrane or peritoneum.

The gut is now in three strips varying from $\frac{1}{4}$ to 1 inch in width. Chemically the gut now consists principally of collagen, which upon boiling with water is turned into gelatine. In addition there are proteins and albumenoids not convertible into gelatine, and small quantities of fats, resins, waxes, and inorganic matter. On account of the adhesive quality of the prepared gut it can be twisted into an almost homogeneous strand.

The strips are now placed in the twisting machine, a number of

strips being twisted together according to the size of the strand to be produced. The twisting machine consists of a stationary hook to which one end of the gut is fastened, and a hook in the center of a small wheel to which the other end is fastened, the gut being under slight tension. The wheel is rotated by means of proper machinery, until the gut is twisted to the correct amount. After twisting, the strand is dried under tension, is then sandpapered to remove the rough surface, and is rubbed down with emery paper. The dust is removed by washing with water, after which it is dried, gauged, and made up into rolls for market.

Reference: "Absorbable Animal Ligatures." By Thomas Berryhell, Medical Director, U. S. Navy.

(*To be continued.*)

DENTAL SERVICE IN CANADA. *The Army and Navy Journal* says that there is now in operation at Toronto, Canada, the biggest and finest military dental clinic in the whole Dominion. The building, 155 feet in length by 50 in width, is the only one painted throughout in white. . . . Since the start of the war the dental clinic in the Toronto military district has, by attending to the teeth of recruits, made possible the enlistment of 10,000 men who otherwise would have been rejected as unfit for overseas service. In the dental building at Toronto already 100 soldiers are being treated daily, and 450 operations performed. There are twenty-five dental chairs. Sixteen officers and twenty-five N. C. O.'s now compose the dental staff. Later the staff will be increased to about double the number. . . . In the dental stores department, are nearly $10,000 of dental supplies and equipment. The stores include a complete stock of drugs, apparatus and artificial teeth. The dental building is modern in every way, electric lights in all rooms, also hot and cold water beside each chair.—From the *Journal of the National Dental Association.*